



**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**

**REGION IX**

**75 Hawthorne Street**

**San Francisco, CA 94105-3901**

JUL 17 2002

Pam Sihvola  
Co-Chair CMTW  
P.O. Box 9046  
Berkeley, CA 94709

Mark MacDonald  
Acting Co-Chair CMTW  
1815 Parker Street  
Berkeley, CA 94703

Dear Ms. Sihvola and Mr. MacDonald:

Thank you for your letter of April 12, 2002 to Regional Administrator Wayne Nastri (Enclosure 1) submitting your Supplemental Vegetation Sampling and Analysis Plan for the Lawrence Berkeley National Laboratory (LBNL), to which he has asked me to respond. We have reviewed your plan and have provided it to LBNL for their comments. After reviewing your supplemental plan and LBNL's comments of June 14, 2002 (Enclosure 2), we conclude that no further vegetation sampling is warranted.

Regarding your concern on the validity of the August 2001 Vegetation Sampling Plan, after touring the site on February 13, 2002, we requested in our March 26, 2002 letter that LBNL provide information on the changes to sampling locations and the tree diameters (Enclosure 3). After reviewing their response of April 24, 2002 (Enclosure 4) we conclude that the sampling that was carried out meets the intent of the approved vegetation sampling plan for tritium, which was to use the vegetation data to help characterize the presence of tritium in the environment.

All vegetation samples required under the August, 2001 plan have been collected and analyzed, along with an appropriate number of EPA split samples (Enclosure 5). Although there are no public health standards for tritium in trees, there are no significant exposure pathways to humans from the levels of tritium that exist in the vegetation. The drinking water maximum contamination level (MCL) of 20,000 pCi/L for tritium is a very protective benchmark - given that trees are not consumed - and no water samples exceed the MCL. The preliminary remediation goal (PRG) is 11,000 pCi/gram for residential soil and none of the solid samples exceed that level. Therefore, tritium in trees around the hillside stack does not pose a health hazard to the public. Additionally, it is clear that the tritium concentrations in trees decrease rapidly with distance from the stack, to regional background levels. We understand that LBNL's evaluation of the supplemental vegetation samples collected will include an analysis of public health impacts, and we look forward to receiving this information.

Ms. Sihvola  
Mr. MacDonald  
CMTW

Page 2.

Since the samples are not of public health concern, and further sampling is not needed for NESHAP or Superfund purposes, we believe that the vegetation sampling is complete and no additional sampling is required. However, we will continue to review the annual NESHAP reports as required under the Clean Air Act NESHAP program and will review data from LBNL's ambient air monitors.

Yours sincerely,



Michael S. Bandrowski, Chief  
Radiation and Compliance Assurance Office

Enclosures

cc: Representative Barbara Lee, w/enclosures  
Richard Nolan, DOE, w/enclosures  
Carl Schwab, DOE, w/enclosures  
Hemant Patel, DOE, w/enclosures  
Waqar Ahmad, DTSC, w/ enclosures  
Mohinder Sandhu, DTSC, w/ enclosures  
Ron Pauer, LBNL, w/ enclosures  
David McGraw, LBNL, w/enclosures  
Paul Lavelly, University of California, w/enclosures  
Michael Bessette Rochette, RWQCB, w/enclosures  
Nabil Al-Hadithy, City of Berkeley, w/enclosures  
Mayor Shirley Dean and Members of the Berkeley City Council, w/enclosures  
Mayor Jerry Brown and Members of the Oakland City Council, w/enclosures

**Committee to Minimize Toxic Waste**

Wayne Nastri, Regional Administrator  
Keith Takata, Director Superfund Division  
Jane Diamond, Acting Director Superfund Division  
Michael S. Bandrowski, Chief, Radiation and Compliance  
US EPA Region IX  
75 Hawthorn Street  
San Francisco, CA 94105

April 12, 2002

Re: Supplemental Vegetation Sampling and Analysis Plan For the Lawrence Berkeley National Laboratory

Dear Sirs and Madam,

This letter is a follow up to CMTW's March 8, 2002 letter concerning our meeting with US EPA's Superfund Staff, MS. Curnow and Air Division staff Mr. Bandrowski and Ms. Wood on Wednesday, February 13, 2002 at the Lawrence Hall of Science, and in response to US EPA's correspondence of December 20, 2001 to CMTW. As you will recall, we asked for a site visit to verify our claim that trees in LBNL's Vegetation Sampling Plan had been cut down prior to EPA's approval of the Plan.

During our site investigation, US EPA staff concurred that the trees actually sampled were not those designated in the plan, either because those in the plan had been cut down or because other trees had been substituted for those designated to be sampled. All agreed that the missing trees have destroyed the credibility of the current sampling plan. As a remedy Mr. Banderowski requested that CMTW provide a new Vegetation Sampling Plan. Below is our plan which proposes five sampling efforts. See attached site map for locations.

**A. Tritium as a Function of Distance from the NTLF Stack (AREA 1)**

In 1996, Dr. Leticia Menchaca collected tree foliage from 25 trees located along two transects (west-east and north-south) centered near the NTLF Stack. The samples were analyzed both for organically-bound tritium and tritium in tissue free water. The purpose of the sampling was "to establish baseline values for tritium." These data were reported in LBNL's 1996 Site Environmental Report (see Attachment 1). The organically-bound tritium activity in some of the samples was extremely high (i.e., 200 to 500 pCi/g) and gave rise to community concern that LBNL's routine monitoring was not accurately categorizing emissions. Another reason for concern was that the NTLF

was closed for several months in 1996, which suggested that high numbers might be reflecting tritium that had been released several years previously.

We propose that the 1996 study be replicated as closely as possible and that all surviving trees be sampled in the same way there were sampled in 1996. Dr. Menchaca, who originally designed the 1996 Tritium in Vegetation Sampling Plan, has offered to oversee the re-sampling effort. It should be conducted by an independent third party acceptable to CMTW (see Attachment 2).

#### **B. Hillside between the NTLF and the Tritium Stack (AREA 2)**

Additional trees must be sampled on the hillside between the NTLF and the tritium stack in order to characterize the extent of tritium contamination along and under the underground portion of the Tritium Stack. This will allow a determination as to whether there have been tritium condensate leaks to the soil due to the corrosion of the stack (see Attachment 3). The samples in this area would be evapotranspired water from mature trees.

#### **C. The Chicken Creek Tritium Plume (AREA 3)**

LBNL reports have already documented the existence of a groundwater tritium plume that extends down Chicken Creek; what is not clear, however, is the rate at which it is moving downslope towards the Strawberry Canyon Recreation Facility. The proposed sampling will help to clarify the situation, and also provide data on tritium activity levels within the plume.

We request that evapotranspired water be collected on a monthly basis from at least 8 mature trees evenly spaced down Chicken Creek. The samples should be collected during the dry season (May through October) in order to minimize the dilution effects of winter rainfall. Samples would be collected with plastic bags sealed on to leafy branches for an appropriate time interval. The samples would then be analyzed for tritium activity.

#### **D. The Blackberry Creek Tritium Plume (AREA 4)**

LBNL has not yet officially admitted the existence of a tritium groundwater plume in the upper section of Blackberry Creek but there are very good reasons for believing that one exists. For example Raju (1995) in a study of tritium in Strawberry and Blackberry Creeks found that Blackberry Creek samples had on average 1.6 times more tritium than Strawberry Creek samples. Menchaca (1996) also found that tritium levels in environmental samples were typically higher on the northwestern side of the stack than on the south and eastern sides. She attributed this to the fact that the prevailing wind direction in winter, when most of the tritium washout occurs, is south easterly, i.e., towards the north and west.

We propose that the same sampling strategy be followed in the upper section of Blackberry Creek as in Chicken Creek. Evapotranspired water should be collected from 8 mature trees on a monthly basis during the summer (May - October) and analyzed for tritium activity.

### E. Reconstruction of Tritium Releases by Means of Tree Ring Analysis

LBNL has already spent a considerable amount of money on the analysis of organically-bound tritium in trees near the NTLF stack. Unfortunately, the sampling methods used have not been precise enough to allow for annual or even biannual sampling. In addition, the analytical methods used to determine organically-bound tritium have been inappropriate.

What we propose here is that three trees be selected for tree ring analysis of organically-bound tritium: one in the Eucalyptus grove next to the NTLF stack; one on Chicken Creek; and one on Blackberry Creek. The Eucalyptus grove tree has already been selected; it was chosen by US EPA and CMTW members during the field trip/meeting of February 13, 2002. The Chicken Creek and Blackberry Creek trees should be selected to make sure they are at least 50 years old and that they contain countable rings. The Eucalyptus grove tree will be cut and sections of trunk sub-sampled for analysis; the Chicken and Blackberry Creek trees should be sampled with a Swedish Increment Corer, or another coring device capable of recovering an intact sequence of rings. All organically bound tritium analyses should be done on cellulose rather than whole wood because of the possibility of lateral movement of organic material within the trunk.

We feel that reconstruction of tritium releases by analysis of tritium activity in tree rings will be an important check on LBNL's emissions data. Bernd Franke, the City of Berkeley consultant on the Tritium Problem at the NTLF, has endorsed the usefulness of this approach. The analyses should be carried out by an independent third party acceptable to CMTW.

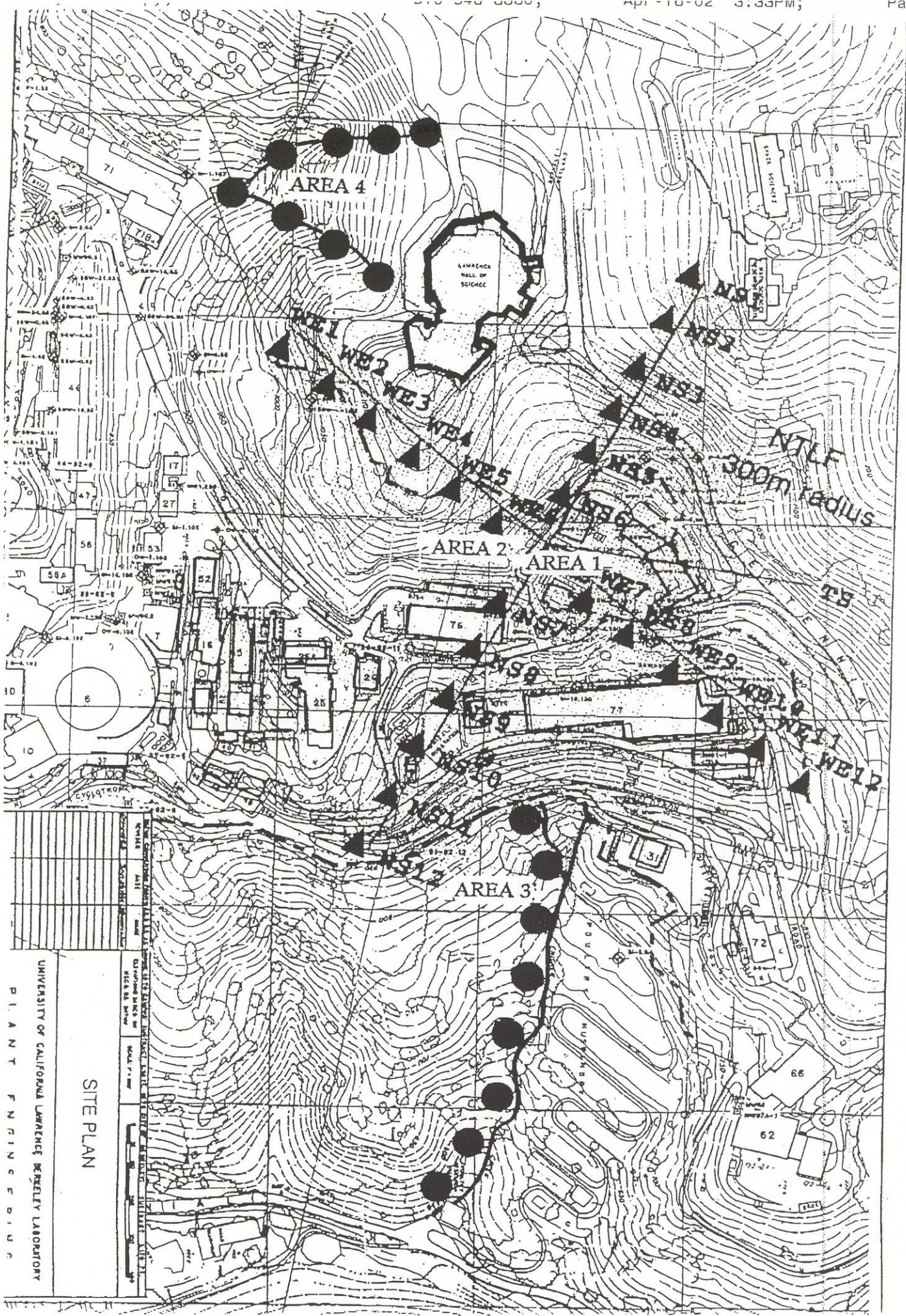
Yours sincerely,



Pamela Sihvola  
Co-Chair CMTW  
P O. Box 9046  
Berkeley, CA 94709



Mark MacDonald  
Acting Co-Chair CMTW  
1815 Parker Street  
Berkeley, CA 94703



Supplemental Vegetation Sampling and Analysis Plan  
For the Lawrence Berkeley National Laboratory



Encl. 2

Environment, Health & Safety Division  
Environmental Services Group

June 14, 2002  
ES-02-059

Mr. Michael Bandrowski  
United States Environmental Protection Agency, Region IX  
75 Hawthorne Street  
San Francisco, CA 94105-3901

Subject: Committee to Minimize Toxic Waste Letter Regarding Supplemental Vegetation Sampling and Analysis Plan for the Lawrence Berkeley National Laboratory

Dear Mr. Bandrowski:

As requested, we have carefully reviewed the Committee to Minimize Toxic Waste (CMTW) letter dated April 12, 2002, which proposes five additional sampling activities at the Berkeley Lab site, and have the following comments.

On May 7, 2002, we successfully completed all sampling activities that the Berkeley Lab committed to under the Tritium Sampling and Analysis Plan, which included sampling of ambient air, soil, sediment, surface water and vegetation. Prior to the start of the sampling activities, the EPA reviewed the Plan and the Lab addressed all comments. Following resolution of EPA comments, the Department of Energy (DOE) reviewed the Plan and provided its approval. In addition, the Laboratory organized an Environmental Sampling Project Task Force to provide a forum for local stakeholders to review and provide comments on the Plan. After presenting the Plan to the Task Force participants and receiving their comments, the sampling activities began in April 2001.

With respect to each of the five sampling activities that were proposed by the CMTW, we offer the following.

**1. Tritium as a Function of Distance from the National Tritium Labeling Facility (NTLF) Stack**

*CMTW proposal: "We propose that the 1996 study be replicated as closely as possible and that the surviving trees be sampled in the same way there [sic] were sampled in 1996. Dr. Menchaca, who originally designed the 1996 Tritium in Vegetation Sampling Plan offered to oversee the re-sampling effort. It would be conducted by an independent third party acceptable to CMTW."*

Since the 1996 study by Dr. Menchaca that was cited in the CMTW letter, vegetation samples have been collected for tritium analysis at approximately 150 on- and off-site locations, representing more than 400 additional results. Please refer to the figure in Attachment 1 for a map showing the vegetation sampling locations near the site. The data from these samples clearly demonstrate a decrease in vegetation tritium levels with increasing distance from the NTLF stack, as reported in Berkeley Lab's annual Site Environmental Reports for the past three years. Please refer to the graphs in Attachment 2 that show the reduction in tritium levels with respect to distance. The most recent set of vegetation samples collected in 2001, as a part of the Task Force's Tritium Sampling and Analysis Plan, also support this conclusion. Thus, the additional sampling requested by the CMTW to replicate Dr. Menchaca's 1996 study is redundant and not likely to improve our understanding of tritium distributions around the hillside stack.

## **2. Hillside between the NTLF and the Hillside Stack**

*CMTW proposal: “Additional trees must be sampled on the hillside between the NTLF and the tritium stack in order to characterize the extent of tritium contamination along and under the underground portion of the Tritium Stack. This will allow a determination as to whether there have been tritium condensate leaks to the soil due to the corrosion of the stack. ... The samples in this area would be evapotranspired water from mature trees.”*

There are no trees on the hillside above the underground portion of the stack. Furthermore, the most direct method of characterizing the soil condition along and under the underground portion of the hillside stack is to sample and analyze the soil. Such samples have already been collected, as discussed in the April 2002 document, “Work Plan for Additional Soil Sampling at the Former National Tritium Labeling Facility.” Samples were collected at nine locations beneath the underground portion of the stack. Please refer to Attachment 3 for a figure showing the field sampling locations (1 through 8 and 10). Once received and validated, the sample results will be incorporated into a report that will be submitted to DOE and regulatory agencies, and copies will be made available to the public at the UC Berkeley Main Library.

CMTW has proposed a non-standard and indirect method for characterizing tritium in soil by using transpired water. This is a research technique, and there are many factors that must be understood to interpret the analytical results accurately. Transpiration is affected by the amount of sunlight falling on a tree’s leaves, the humidity of the air surrounding the tree, the depth and distribution of its roots, the soil water that is taken up by its roots, and many other factors. Even if all of these factors could be resolved, there are no trees above the underground portion of the stack, as mentioned above.

## **3. Chicken Creek Tritium Plume**

*CMTW Proposal: “We request that evapotranspired water be collected on a monthly basis from at least 8 mature trees evenly spaced down Chicken Creek. The samples should be collected during the dry season (May through October) in order to minimize the dilution effects of winter rainfall. Samples would be collected with plastic bags sealed on to leafy branches for an appropriate time interval. The samples would then be analyzed for tritium activity.”*

For the same reasons noted in our response to question #2, transpired water is not the preferred method of measuring tritium in the ground along Chicken Creek. The most direct method of measuring tritium in the ground is to sample and analyze the soil and/or groundwater. Such samples have been collected over the course of the last five years, and there are currently over 30 wells that monitor the quality of groundwater in the Chicken Creek drainage area. Please refer to Attachment 4 for a figure showing these sampling well locations and tritium levels. The analytical results of these samples indicate the amount and extent of contamination in the groundwater. Additional investigation activities are planned, using conventional techniques, to further characterize the subsurface environment in front of the tritium plume. The results of these investigations will help us further understand the rate of groundwater movement in this area. These activities are being performed under DOE oversight and in consultation with the Department of Toxic Substances Control, Regional Water Quality Control Board, and the City of Berkeley. As is the case for all Environmental Restoration Program activities, the results of these activities will be made available at the UC Berkeley Doe Library in the Quarterly Progress Reports.

## **4. North Fork of Strawberry Creek**

*CMTW Proposal: “We propose that the same sampling strategy be followed in the upper section of Blackberry Creek as in Chicken Creek. Evapotranspired water should be collected from 8 mature trees on a monthly basis during the summer (May-October) and analyzed for tritium activity.”*

Tritium levels in the North Fork of Strawberry Creek (referred to as Blackberry Creek by CMTW) are lower than those found in Chicken Creek. For example, in 2001, tritium was detected (at a detection limit of 200 picocuries per liter [pCi/L]) in about 15% of the samples taken from the North Fork of Strawberry

Creek and the maximum level was 270 pCi/L. By comparison, tritium was found in about 85% of the samples taken from Chicken Creek, and the maximum level was 870 pCi/L. The maximum levels in both creeks are more than 20 times less than the drinking water standard; although, this water is not used for the public drinking water supply system. The tritium levels in both creeks do not represent a public health hazard.

We believe that the low tritium concentrations detected in the North Fork of Strawberry Creek are related to surface water runoff and to tritium air emissions. To investigate this pathway, we will increase the frequency of our routine sampling program at North Fork of Strawberry to monthly starting in January 2003 for a period of one year. Closure activities at the NTLF will result in reduced air emissions to the environment, which will reduce tritium levels in surface water runoff. If the tritium levels in the North Fork of Strawberry Creek are due to surface water runoff, then tritium levels should decrease in the creek as well following closure activities at the NTLF. The samples will be collected as a part of our ongoing environmental monitoring program. The results will be reported in the Site Environmental Report for 2003.

## **5. Reconstruction of Tritium Releases by Tree Ring Analysis**

*CMTW proposal: "We feel that reconstruction of tritium releases by analysis of tritium activity in tree rings will be an important check on LBNL's emissions data. Bernd Franke, the City of Berkeley consultant on the Tritium Problem [sic] at the NTLF, has endorsed the usefulness of this approach. The analyses should be carried out by an independent third party acceptable to CMTW."*

A Ph.D. candidate at UC Berkeley's Department of Civil and Environmental Engineering has completed a study that correlates tritium emitted from NTLF in past years with organically bound tritium (OBT) in tree rings. He successfully used a very sensitive analytical technique, accelerator mass spectroscopy, to measure carbon-14 and organically bound tritium in rings of trees near the NTLF. He correlated carbon-14 levels in tree rings to known atmospheric levels of carbon-14 to assign dates to the rings. Then, he correlated the tritium levels in the rings to reported tritium emissions from the NTLF, and found that variations in the tree ring OBT levels correlated well with variations in the reported tritium emissions from the NTLF. Thus, the historical air emission data from the Lab are validated by this tree ring study performed by UC Berkeley.

The Ph.D. thesis, expected to be published this summer, will provide a scientifically valid reconstruction of tritium emissions using tree ring analysis.

I hope you find this information is useful. If you have any questions, please feel free to contact me at (510) 486-7614.

Sincerely,

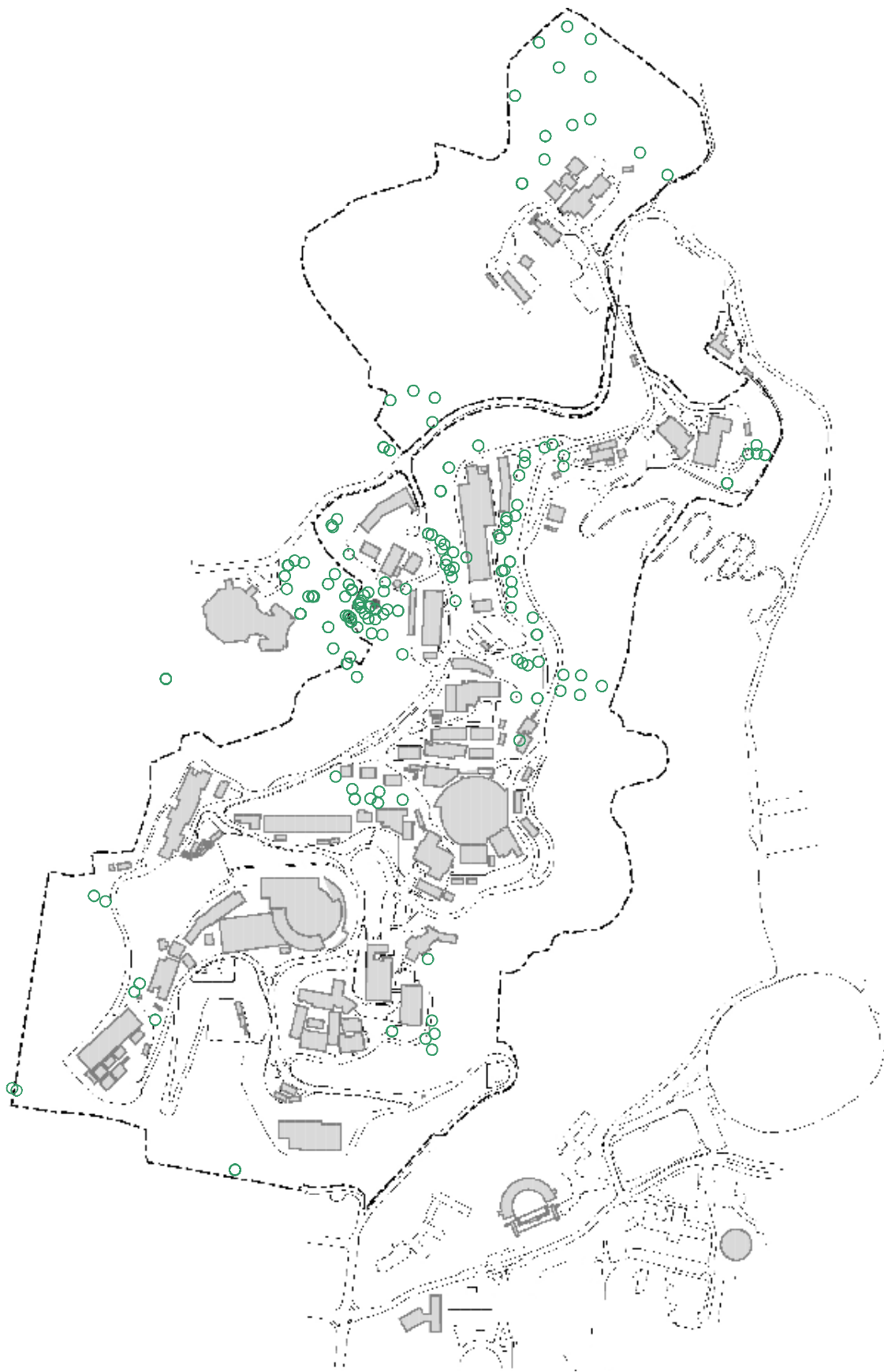
Ron Pauer  
Environmental Services Group Leader

encls: Attachments 1 to 4

cc w/encls:

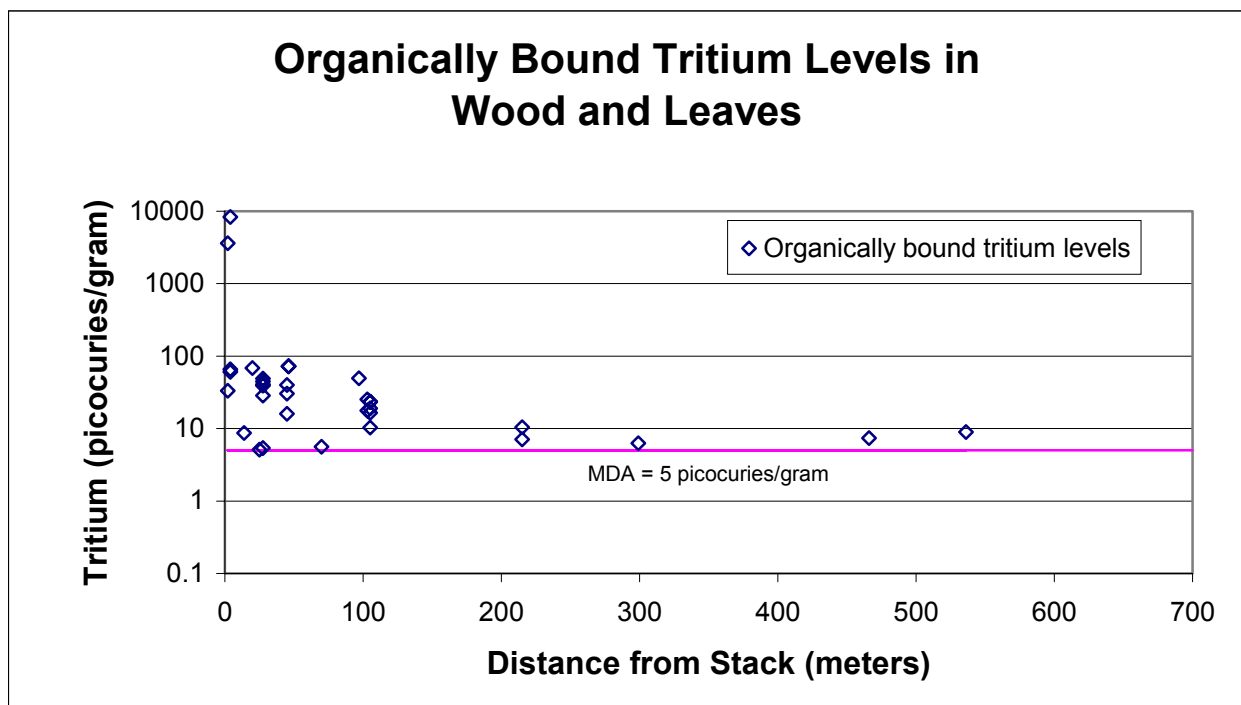
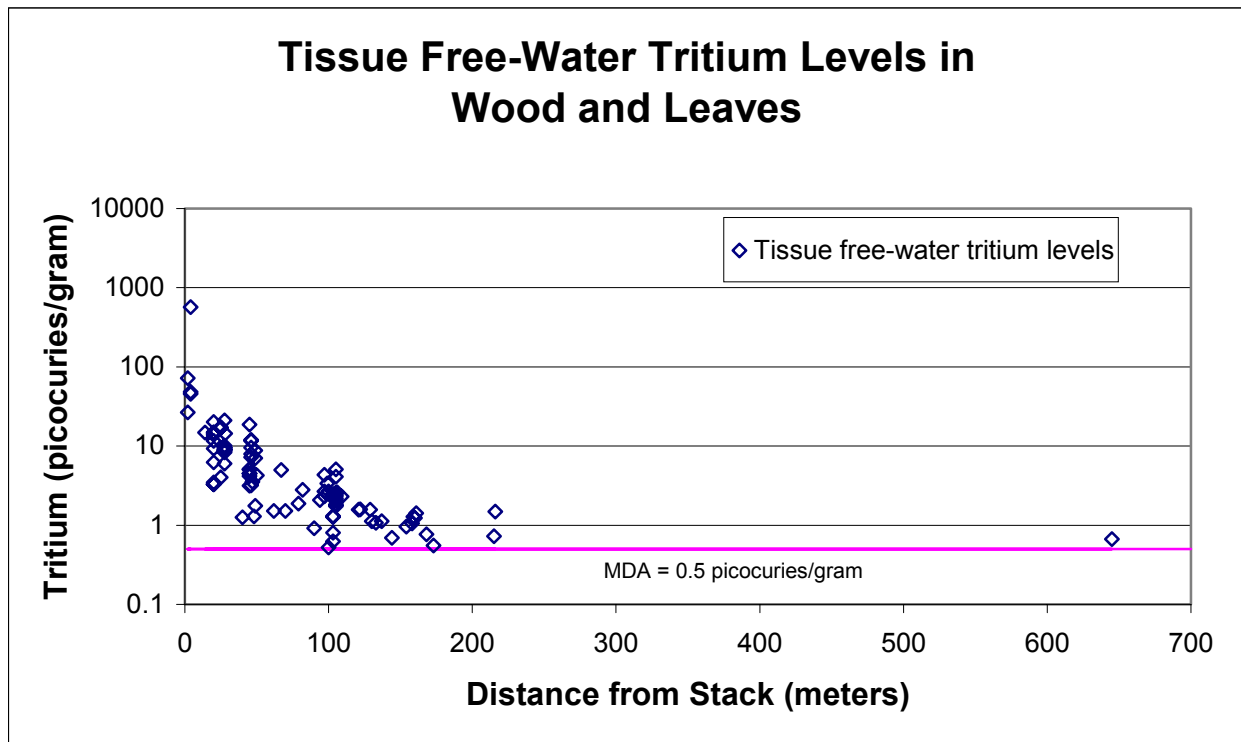
I. Javandel  
C. Schwab, DOE

**Attachment 1**  
**Approximate Vegetation Sampling Locations for Tritium Near the Berkeley Lab Site**



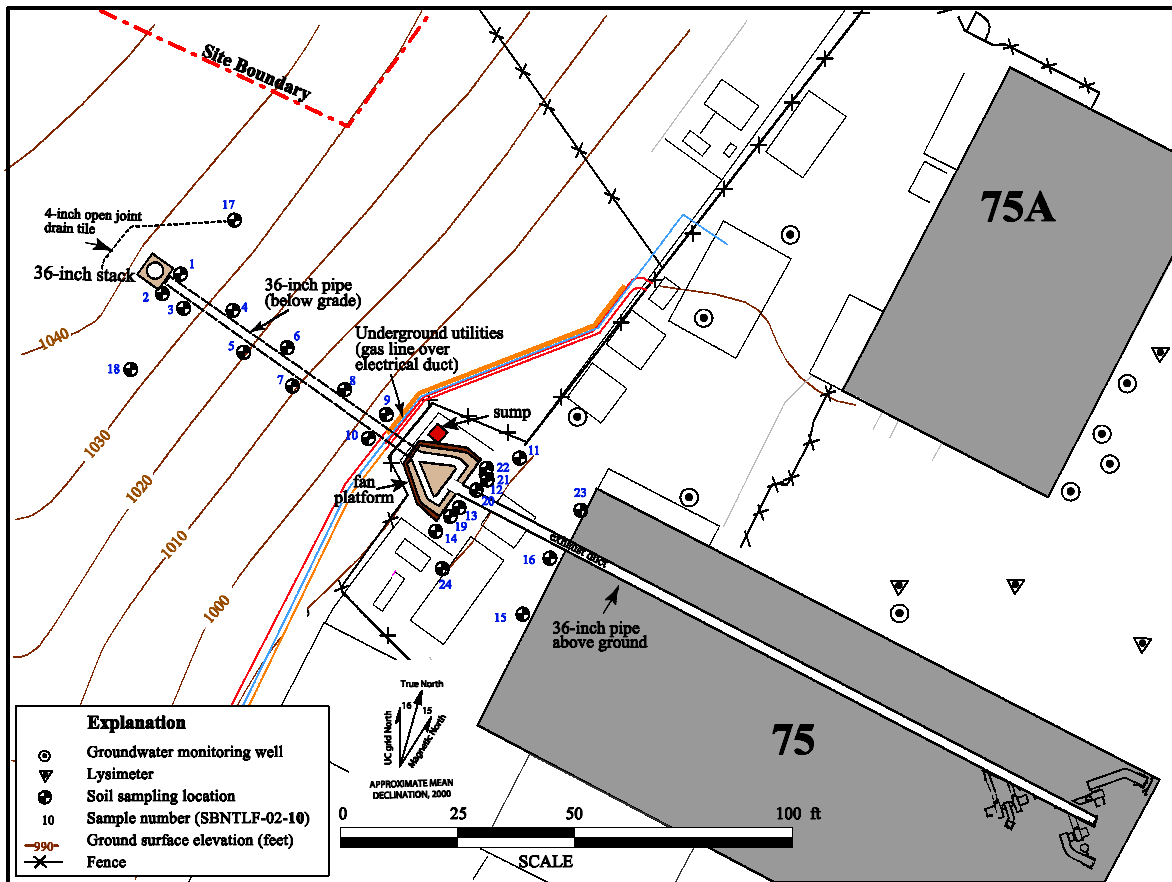
## Attachment 2

### Reduction in Tritium Levels in Vegetation with Respect to Distance from the Hillside Stack

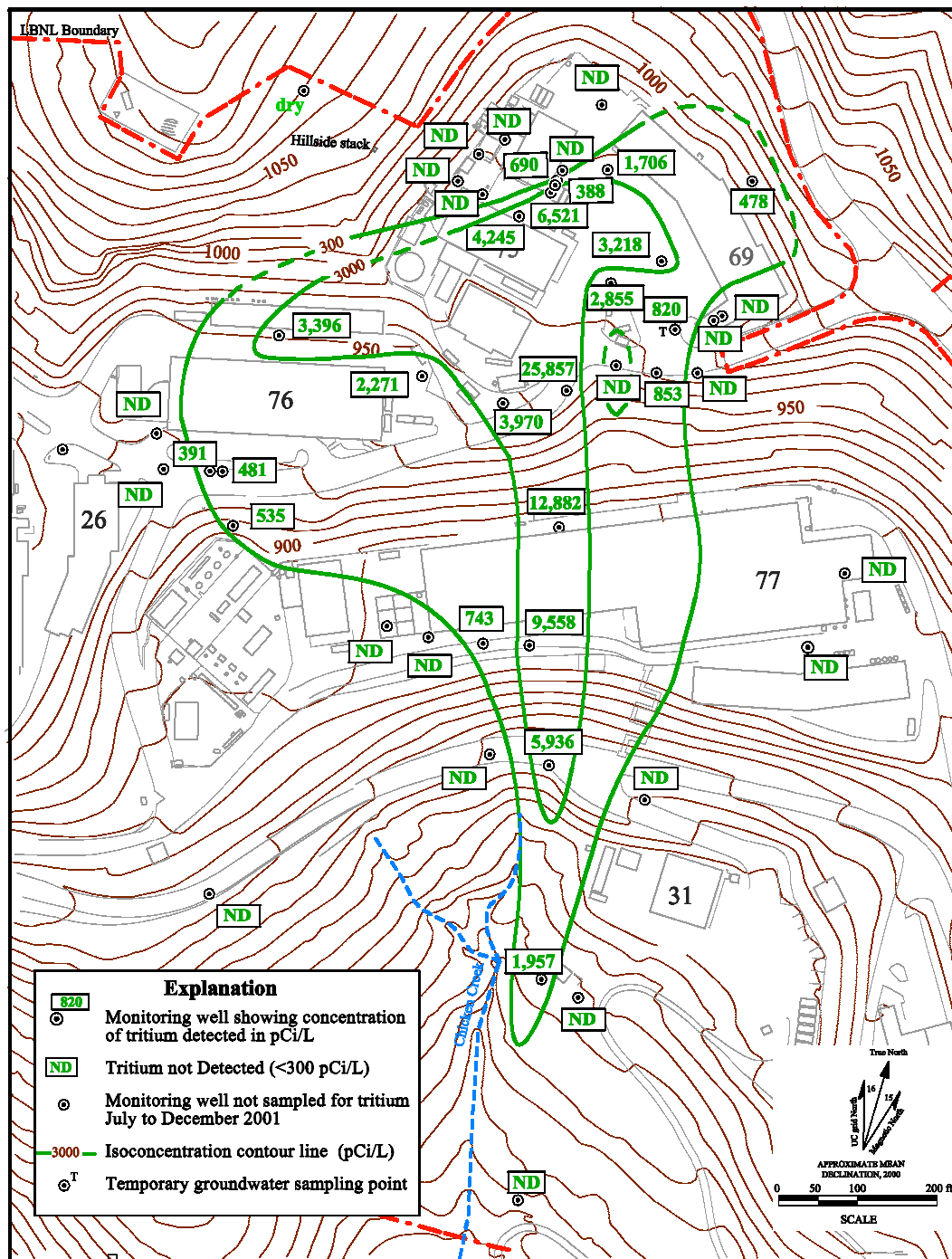


### Attachment 3

## Soil Sampling Locations in the Area of the Hillside Stack, April 2002



# Attachment 4 Tritium Concentrations in Groundwater (picocuries/liter) in the Upper Chicken Creek Drainage Area July to December 2001





## UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IX

75 Hawthorne Street  
San Francisco, CA 94105-3901

March 26, 2002

Ron Pauer  
Lawrence Berkeley National Laboratory  
1 Cyclotron Road, MS-75B-117  
Berkeley, CA 94720

Dear Mr. Pauer:

Thank you for hosting our site visit on February 13, 2002. There have been some changes between the proposed sampling locations shown on the draft Vegetation Sampling Plan for Tritium (August, 2001) and the actual sampling locations we saw in the field. It appears that some locations may have been impacted by tree removal activities by UC before the samples could be collected.

Please provide EPA and the Committee to Minimize Toxic Waste (CMTW) with the latest revised table comparing the direction and distance from the NTLF stack of the proposed trees with the actual trees, and their diameters. I understand that during Periann Wood's site visit in August, 2001 there was some discussion of the rationale for sampling locations and a table was prepared showing the actual locations. If any of the actual locations are significantly different from the vegetation sampling plan, please provide an explanation for the changes from the plan and any justification.

During our site tour on February 13, 2002, members of the CMTW indicated that they would like additional trees sampled and analyzed for tritium. At the end of the visit, it was understood that the CMTW would submit a supplemental vegetation sampling plan to us, and that the Berkeley Lab will review it and consider collecting additional samples.

If you have any questions, please contact me at 415-947-4194.

Sincerely

A handwritten signature in black ink, appearing to read "m. s. bandrowski", followed by a horizontal line.

Michael S. Bandrowski, Chief  
Radiation and Compliance Officecc: Carl Schwab, DOE  
Pam Shivola, CMTW  
Gene Bernardi, CMTW  
L.A. Wood, CEAC  
Nabil Al-Hadithy, City of Berkeley



Environment, Health & Safety Division  
Environmental Services Group

April 24, 2002  
ES-02-049

Mr. Michael Bandrowski  
United States Environmental Protection Agency, Region IX  
75 Hawthorne Street  
San Francisco, CA 94105-3901

Subject: Vegetation Sampling Plan – Proposed Sampling Locations

Dear Mr. Bandrowski:

I would like to thank you and your staff for taking the time to visit our vegetation sampling sites at Berkeley Lab, first in August 2001 and most recently in February 2002. This letter is in response to your request for information (EPA letter dated March 26, 2002) pertaining to the locations of vegetation samples collected in September and November 2001, as part of the Vegetation Sampling Plan for Tritium. In order to respond, a brief chronology is presented below of the planning and collection process for vegetation, and the table that you requested is attached.

Over the past four years, Berkeley Lab has taken hundreds of vegetation samples and has obtained a large set of data pertaining to tritium in vegetation. Data clearly indicate that tritium concentrations in the tree grove around the Building 75 hillside stack decrease with distance. In addition, data indicate that tritium concentrations do not change abruptly between trees within the same general area. With greater distance from the stack, variation of data, between trees in the same general area, decreases even further. This information was used in the development of the vegetation sampling plan.

The sampling plan was developed to further characterize tritium concentrations in trees near the Berkeley Lab hillside stack and the Lawrence Hall of Science. The results from the sampling will be used to evaluate the potential for adverse impact by comparing the sample results to computer-modeled values that were used in Dr. McKone's *Environmental Health-Risk Assessment for Tritium Releases at the National Tritium Labeling Facility at Lawrence Berkeley National Laboratory*, April 1997.

The plan identifies general areas where vegetation samples were to be collected—not specific trees. Within these general areas, the plan requires that tree selection be guided by the availability of vegetation: i.e., available mature trees at a location, available appropriate species, and accessible vegetation for sampling. During the site visit on August 2001, representatives from EPA and the Berkeley Lab specifically reviewed the trees selected at three locations: WNW4, SSE7, and WWW8. It was agreed that the selected trees were

acceptable, given the limitations of available vegetation. Vegetation sampling was  
→ performed later, in September and November 2001, on those trees.

As requested, a table comparing proposed and actual locations and showing tree diameters is enclosed. The information in the enclosed table illustrates that actual sample locations were at or near the general proposed locations. Differences between proposed and actual sample locations are due to the application of the sampling plan criteria and the physical limitations of field sampling. The actual sampling locations were reviewed by EPA in August 2001 and fully meet the requirements of the vegetation sampling plan.

If you have any questions, please feel free to contact me at (510) 486-7614.

Sincerely,

Ron Pauer  
Environmental Services Group Leader

enclosure:

cc w/enclosure:

Carl Schwab, DOE  
Pam Sihvola, CMTW  
Gene Bernardi, CMTW  
L.A. Wood, CEAC  
Nabil Al-Hadithy, City of Berkeley

## 2001 Vegetation Sampling Locations

Location Number	Tree Diameter (cm)	Proposed Sample Locations		Actual Sample Locations	
		Direction from NTLF Stack	Distance from NTLF Stack (m)	Direction from NTLF Stack	Distance from NTLF Stack (m)
NNW1	48-52 <sup>b</sup> 28-30 <sup>c</sup>	NNW	20	NNW	7.4±7 <sup>a</sup> 27.5 <sup>d</sup>
NNW2	40-47	NNW	100	NNW	105 ± 12 <sup>a</sup>
NNW3	55-68	NNW	300	NNW <sup>e</sup>	363 ± 7 <sup>a</sup>
WNW4	39-44.5	WNW	100	WSW	103 ± 10 <sup>a</sup>
NNN5	46-49	N	50	N	45 ± 6 <sup>a</sup>
EEE6	49-51	E	200	E <sup>e</sup>	215 ± 8 <sup>a</sup>
SSE7	53-70	SSE	600	SSE <sup>e</sup>	529 ± 8 <sup>a</sup>
WWW8	46-49	W	850	W <sup>e</sup>	832 ± 34 <sup>a</sup>
SEE9	36-40	SE	20,000	SE <sup>e</sup>	20,800 ± 12 <sup>a</sup>
NEE10	34-37	NE	1,000	NE <sup>e</sup>	1080 ± 12 <sup>a</sup>

<sup>a</sup> Based on GPS reading

<sup>b</sup> Diameter of tree sampled for wood and duff; leaves not accessible so nearby, smaller, tree sampled for leaves and transpired water

<sup>c</sup> Diameter of tree sampled for leaves and transpired water; tree too small for wood sample so nearby, larger tree sampled for wood and duff

<sup>d</sup> Based on tape measure reading

<sup>e</sup> Not in direct sight of NTLF stack so direction is estimated

## COMPARISON OF LBNL/EPA VEGETATION SAMPLING DATA

The following table compares the results of the vegetation sampling performed by LBNL and EPA. Eberline did the laboratory analysis for LBNL, and the University of Georgia did the analysis for EPA.

The Quality Control Type Samples listed as "Split" were analyzed by the University of Georgia, with oversight by EPA's National Air and Radiation Environmental Laboratory (NAREL) in Montgomery, Alabama.

The Quality Control Type Samples listed as "Primary" and as "Duplicate" were done by Eberline. The distance and direction of the sample location from the stack are also indicated. The abbreviations used are explained at the end of the Table.

Location & Sample Type	Direction	Distance frm NTLF Stack (m)	Analysis	Collection Date	Reported Result	Required MDA	Units: picoCuries per gram or per Liter	Quality Control Type Samples
NNW1-Chip	NNW	20	OBT	9/13/2001	ND	5	pCi/g	Primary
NNW1-Chip	NNW	20	OBT	9/13/2001	ND	5	pCi/g	Duplicate
NNW1-Chip	NNW	20	OBT	11/29/2001	5.38	5	pCi/g	Primary
NNW1-Chip	NNW	20	OBT	11/29/2001	ND	5	pCi/g	Split
NNW1-Chip	NNW	20	OBT	11/29/2001	ND	5	pCi/g	Duplicate
NNW1-Chip	NNW	20	TFWT	9/13/2001	8.35	0.5	pCi/g	Duplicate
NNW1-Chip	NNW	20	TFWT	9/13/2001	9.58	0.5	pCi/g	Primary
NNW1-Chip	NNW	20	TFWT	11/29/2001	8.67	0.5	pCi/g	Primary
NNW1-Chip	NNW	20	TFWT	11/29/2001	9.54	0.5	pCi/g	Duplicate
NNW1-Chip	NNW	20	TFWT	11/29/2001	10.13	0.5	pCi/g	Split
NNW1-Duff	NNW	20	OBT	9/13/2001	238	5	pCi/g	Primary
NNW1-Duff	NNW	20	OBT	9/13/2001	292	5	pCi/g	Duplicate
NNW1-Duff	NNW	20	OBT	11/29/2001	119	5	pCi/g	Primary
NNW1-Duff	NNW	20	OBT	11/29/2001	132.16	5	pCi/g	Split
NNW1-Duff	NNW	20	OBT	11/29/2001	142	5	pCi/g	Duplicate
NNW1-Duff	NNW	20	TFWT	9/13/2001	1.22	0.5	pCi/g	Primary
NNW1-Duff	NNW	20	TFWT	9/13/2001	1.67	0.5	pCi/g	Duplicate
NNW1-Duff	NNW	20	TFWT	11/29/2001	6.64	0.5	pCi/g	Split
NNW1-Duff	NNW	20	TFWT	11/29/2001	9.26	0.5	pCi/g	Primary
NNW1-Duff	NNW	20	TFWT	11/29/2001	9.3	0.5	pCi/g	Duplicate
NNW1-Leaf	NNW	20	OBT	9/13/2001	40.8	5	pCi/g	Primary
NNW1-Leaf	NNW	20	OBT	9/13/2001	48.8	5	pCi/g	Duplicate
NNW1-Leaf	NNW	20	OBT	11/29/2001	28.5	5	pCi/g	Primary
NNW1-Leaf	NNW	20	OBT	11/29/2001	39.01	5	pCi/g	Split
NNW1-Leaf	NNW	20	OBT	11/29/2001	44.9	5	pCi/g	Duplicate
NNW1-Leaf	NNW	20	TFWT	9/13/2001	6.03	0.5	pCi/g	Duplicate
NNW1-Leaf	NNW	20	TFWT	9/13/2001	8.92	0.5	pCi/g	Primary
NNW1-Leaf	NNW	20	TFWT	11/29/2001	8.97	0.5	pCi/g	Primary
NNW1-Leaf	NNW	20	TFWT	11/29/2001	9.19	0.5	pCi/g	Duplicate
NNW1-Leaf	NNW	20	TFWT	11/29/2001	21.07	0.5	pCi/g	Split
NNW1-TW	NNW	20	Tritium	9/24/2001	13000	200	pCi/L	Duplicate
NNW1-TW	NNW	20	Tritium	9/24/2001	13600	200	pCi/L	Primary

	NNW	20	Tritium	1/3/2002	8750	200	pCi/L	Primary
	NNW	20	Tritium	1/3/2002	9609	200	pCi/L	Split
NNW1-TW	NNW	20	Tritium	1/3/2002	11400	200	pCi/L	Duplicate
NNW2-Chip	NNW	100	OBT	9/13/2001	ND	5	pCi/g	Split
NNW2-Chip	NNW	100	OBT	9/13/2001	ND	5	pCi/g	Primary
NNW2-Chip	NNW	100	OBT	11/29/2001	ND	5	pCi/g	Split
NNW2-Chip	NNW	100	OBT	11/29/2001	ND	5	pCi/g	Primary
NNW2-Chip	NNW	100	TFWT	9/13/2001	1.74	0.5	pCi/g	Split
NNW2-Chip	NNW	100	TFWT	9/13/2001	2.17	0.5	pCi/g	Primary
NNW2-Chip	NNW	100	TFWT	11/29/2001	1.82	0.5	pCi/g	Primary
NNW2-Chip	NNW	100	TFWT	11/29/2001	2.03	0.5	pCi/g	Split
NNW2-Duff	NNW	100	OBT	9/13/2001	24.2	5	pCi/g	Primary
NNW2-Duff	NNW	100	OBT	9/13/2001	38.05	5	pCi/g	Split
NNW2-Duff	NNW	100	OBT	11/29/2001	24.1	5	pCi/g	Primary
NNW2-Duff	NNW	100	OBT	11/29/2001	57.24	5	pCi/g	Split
NNW2-Duff	NNW	100	TFWT	9/13/2001	1.01	0.5	pCi/g	Primary
NNW2-Duff	NNW	100	TFWT	9/13/2001	2.08	0.5	pCi/g	Split
NNW2-Duff	NNW	100	TFWT	11/29/2001	2.61	0.5	pCi/g	Split
NNW2-Duff	NNW	100	TFWT	11/29/2001	3.56	0.5	pCi/g	Primary
NNW2-Leaf	NNW	100	OBT	9/13/2001	16.47	5	pCi/g	Split
NNW2-Leaf	NNW	100	OBT	9/13/2001	23.6	5	pCi/g	Primary
NNW2-Leaf	NNW	100	OBT	11/29/2001	19.06	5	pCi/g	Split
NNW2-Leaf	NNW	100	OBT	11/29/2001	23.3	5	pCi/g	Primary
NNW2-Leaf	NNW	100	TFWT	9/13/2001	2.58	0.5	pCi/g	Primary
NNW2-Leaf	NNW	100	TFWT	9/13/2001	5.07	0.5	pCi/g	Split
NNW2-Leaf	NNW	100	TFWT	11/29/2001	2.35	0.5	pCi/g	Split
NNW2-Leaf	NNW	100	TFWT	11/29/2001	4.1	0.5	pCi/g	Primary
NNW2-TW	NNW	100	Tritium	9/24/2001	3690	200	pCi/L	Primary
NNW2-TW	NNW	100	Tritium	9/24/2001	3708	200	pCi/L	Split
NNW2-TW	NNW	100	Tritium	1/3/2002	3753	200	pCi/L	
NNW2-TW	NNW	100	Tritium	1/3/2002	3920	200	pCi/L	Primary
NNW3-Chip	NNW	300	OBT	9/12/2001	ND	5	pCi/g	Primary
NNW3-Chip	NNW	300	OBT	11/29/2001	ND	5	pCi/g	Primary
NNW3-Chip	NNW	300	TFWT	9/12/2001	ND	0.5	pCi/g	Primary
NNW3-Chip	NNW	300	TFWT	11/29/2001	ND	0.5	pCi/g	Primary
NNW3-Duff	NNW	300	OBT	9/12/2001	ND	5	pCi/g	Primary
NNW3-Duff	NNW	300	OBT	11/29/2001	ND	5	pCi/g	Primary
NNW3-Duff	NNW	300	TFWT	9/12/2001	ND	0.5	pCi/g	Primary
NNW3-Duff	NNW	300	TFWT	11/29/2001	ND	0.5	pCi/g	Primary
NNW3-Leaf	NNW	300	OBT	9/12/2001	ND	5	pCi/g	Primary
NNW3-Leaf	NNW	300	OBT	11/29/2001	ND	5	pCi/g	Primary
NNW3-Leaf	NNW	300	TFWT	9/12/2001	ND	0.5	pCi/g	Primary
NNW3-Leaf	NNW	300	TFWT	11/29/2001	ND	0.5	pCi/g	Primary
NNW3-TW	NNW	300	Tritium	9/19/2001	431	200	pCi/L	Primary
NNW3-TW	NNW	300	Tritium	1/3/2002	384	200	pCi/L	Primary
WNW4-Chip	WNW	100	OBT	9/13/2001	ND	5	pCi/g	Primary
WNW4-Chip	WNW	100	OBT	11/28/2001	ND	5	pCi/g	Primary
WNW4-Chip	WNW	100	TFWT	9/13/2001	0.802	0.5	pCi/g	Primary
WNW4-Chip	WNW	100	TFWT	11/28/2001	0.624	0.5	pCi/g	Primary
WNW4-Duff	WNW	100	OBT	9/13/2001	13.1	5	pCi/g	Primary

WNW4-Duff	WNW	100	OBT	11/28/2001	12.4	5	pCi/g	Primary
WNW4-Duff	WNW	100	TFWT	9/13/2001	1.49	0.5	pCi/g	Primary
WNW4-Duff	WNW	100	TFWT	11/28/2001	1.35	0.5	pCi/g	Primary
WNW4-Leaf	WNW	100	OBT	9/13/2001	17.7	5	pCi/g	Primary
WNW4-Leaf	WNW	100	OBT	11/28/2001	25.2	5	pCi/g	Primary
WNW4-Leaf	WNW	100	TFWT	9/13/2001	2.46	0.5	pCi/g	Primary
WNW4-Leaf	WNW	100	TFWT	11/28/2001	1.3	0.5	pCi/g	Primary
NNN5-Chip	N	50	OBT	9/13/2001	ND	5	pCi/g	Primary
NNN5-Chip	N	50	OBT	11/29/2001	ND	5	pCi/g	Split
NNN5-Chip	N	50	OBT	11/29/2001	ND	5	pCi/g	Primary
NNN5-Chip	N	50	TFWT	9/13/2001	4.17	0.5	pCi/g	Primary
NNN5-Chip	N	50	TFWT	11/29/2001	4.49	0.5	pCi/g	Primary
NNN5-Chip	N	50	TFWT	11/29/2001	4.52	0.5	pCi/g	Split
NNN5-Duff	N	50	OBT	9/13/2001	83.9	5	pCi/g	Primary
NNN5-Duff	N	50	OBT	11/29/2001	62.17	5	pCi/g	Split
NNN5-Duff	N	50	OBT	11/29/2001	77.7	5	pCi/g	Primary
NNN5-Duff	N	50	TFWT	9/13/2001	1.41	0.5	pCi/g	Primary
NNN5-Duff	N	50	TFWT	11/29/2001	3.66	0.5	pCi/g	Split
NNN5-Duff	N	50	TFWT	11/29/2001	4.57	0.5	pCi/g	Primary
NNN5-Leaf	N	50	OBT	9/13/2001	30.4	5	pCi/g	Primary
NNN5-Leaf	N	50	OBT	11/29/2001	16	5	pCi/g	Split
NNN5-Leaf	N	50	OBT	11/29/2001	40	5	pCi/g	Primary
NNN5-Leaf	N	50	TFWT	9/13/2001	5.13	0.5	pCi/g	Primary
NNN5-Leaf	N	50	TFWT	11/29/2001	5.01	0.5	pCi/g	Primary
NNN5-Leaf	N	50	TFWT	11/29/2001	18.75	0.5	pCi/g	Split
EEE6-Chip	E	600	OBT	9/12/2001	ND	5	pCi/g	Primary
EEE6-Chip	E	600	OBT	11/28/2001	ND	5	pCi/g	Primary
EEE6-Chip	E	600	TFWT	9/12/2001	ND	0.5	pCi/g	Primary
EEE6-Chip	E	600	TFWT	11/28/2001	ND	0.5	pCi/g	Primary
EEE6-Duff	E	600	OBT	9/12/2001	14.8	5	pCi/g	Primary
EEE6-Duff	E	600	OBT	11/28/2001	9.39	5	pCi/g	Primary
EEE6-Duff	E	600	TFWT	9/12/2001	ND	0.5	pCi/g	Primary
EEE6-Duff	E	600	TFWT	11/28/2001	0.591	0.5	pCi/g	Primary
EEE6-Leaf	E	600	OBT	9/12/2001	7.12	5	pCi/g	Primary
EEE6-Leaf	E	600	OBT	11/28/2001	10.4	5	pCi/g	Primary
EEE6-Leaf	E	600	TFWT	9/12/2001	0.726	0.5	pCi/g	Primary
EEE6-Leaf	E	600	TFWT	11/28/2001	ND	0.5	pCi/g	Primary
SSE7-Chip	SSE	200	OBT	9/12/2001	ND	5	pCi/g	Primary
SSE7-Chip	SSE	200	OBT	11/28/2001	ND	5	pCi/g	Primary
SSE7-Chip	SSE	200	TFWT	9/12/2001	ND	0.5	pCi/g	Primary
SSE7-Chip	SSE	200	TFWT	11/28/2001	ND	0.5	pCi/g	Primary
SSE7-Duff	SSE	200	OBT	9/12/2001	ND	5	pCi/g	Primary
SSE7-Duff	SSE	200	OBT	11/28/2001	ND	5	pCi/g	Primary
SSE7-Duff	SSE	200	TFWT	9/12/2001	ND	0.5	pCi/g	Primary
SSE7-Duff	SSE	200	TFWT	11/28/2001	ND	0.5	pCi/g	Primary
SSE7-Leaf	SSE	200	OBT	9/12/2001	ND	5	pCi/g	Primary
SSE7-Leaf	SSE	200	OBT	11/28/2001	ND	5	pCi/g	Primary
SSE7-Leaf	SSE	200	TFWT	9/12/2001	ND	0.5	pCi/g	Primary
SSE7-Leaf	SSE	200	TFWT	11/28/2001	ND	0.5	pCi/g	Primary
WWW8-Chip	W	850	OBT	9/12/2001	ND	5	pCi/g	Primary

WWW8-Chip	W	850	OBT	11/28/2001	ND	5	pCi/g	Primary
WWW8-Chip	W	850	TFWT	9/12/2001	ND	0.5	pCi/g	Primary
WWW8-Chip	W	850	TFWT	11/28/2001	ND	0.5	pCi/g	Primary
WWW8-Duff	W	850	OBT	9/12/2001	ND	5	pCi/g	Primary
WWW8-Duff	W	850	TFWT	11/28/2001	ND	5	pCi/g	Primary
WWW8-Duff	W	850	TFWT	9/12/2001	ND	0.5	pCi/g	Primary
WWW8-Duff	W	850	TFWT	11/28/2001	ND	0.5	pCi/g	Primary
WWW8-Leaf	W	850	OBT	9/12/2001	ND	5	pCi/g	Primary
WWW8-Leaf	W	850	OBT	11/28/2001	ND	5	pCi/g	Primary
WWW8-Leaf	W	850	TFWT	9/12/2001	ND	0.5	pCi/g	Primary
WWW8-Leaf	W	850	TFWT	11/28/2001	ND	0.5	pCi/g	Primary
SEE9-Chip	SE	20,000	OBT	9/12/2001	ND	5	pCi/g	Primary
SEE9-Chip	SE	20,000	OBT	11/27/2001	ND	5	pCi/g	Primary
SEE9-Chip	SE	20,000	TFWT	9/12/2001	ND	0.5	pCi/g	Primary
SEE9-Chip	SE	20,000	TFWT	11/27/2001	ND	0.5	pCi/g	Primary
SEE9-Duff	SE	20,000	OBT	9/12/2001	ND	5	pCi/g	Primary
SEE9-Duff	SE	20,000	OBT	11/27/2001	ND	5	pCi/g	Primary
SEE9-Duff	SE	20,000	TFWT	9/12/2001	ND	0.5	pCi/g	Primary
SEE9-Duff	SE	20,000	TFWT	11/27/2001	ND	0.5	pCi/g	Primary
SEE9-Leaf	SE	20,000	OBT	9/12/2001	ND	5	pCi/g	Primary
SEE9-Leaf	SE	20,000	OBT	11/27/2001	ND	5	pCi/g	Primary
SEE9-Leaf	SE	20,000	TFWT	9/12/2001	ND	0.5	pCi/g	Primary
SEE9-Leaf	SE	20,000	TFWT	11/27/2001	ND	0.5	pCi/g	Primary
SEE9-TW	SE	20,000	Tritium	9/19/2001	ND	200	pCi/L	Primary
SEE9-TW	SE	20,000	Tritium	1/3/2002	ND	200	pCi/L	Primary
NEE10-Chip	NE	1,000	OBT	9/12/2001	ND	5	pCi/g	Primary
NEE10-Chip	NE	1,000	OBT	11/27/2001	ND	5	pCi/g	Primary
NEE10-Chip	NE	1,000	TFWT	9/12/2001	ND	0.5	pCi/g	Primary
NEE10-Chip	NE	1,000	TFWT	11/27/2001	ND	0.5	pCi/g	Primary
NEE10-Duff	NE	1,000	OBT	9/12/2001	ND	5	pCi/g	Primary
NEE10-Duff	NE	1,000	OBT	11/27/2001	ND	5	pCi/g	Primary
NEE10-Duff	NE	1,000	TFWT	9/12/2001	ND	0.5	pCi/g	Primary
NEE10-Duff	NE	1,000	TFWT	11/27/2001	ND	0.5	pCi/g	Primary
NEE10-Leaf	NE	1,000	OBT	9/12/2001	ND	5	pCi/g	Primary
NEE10-Leaf	NE	1,000	OBT	11/27/2001	ND	5	pCi/g	Primary
NEE10-Leaf	NE	1,000	TFWT	9/12/2001	ND	0.5	pCi/g	Primary
NEE10-Leaf	NE	1,000	TFWT	11/27/2001	ND	0.5	pCi/g	Primary
NEE10-TW	NE	1,000	Tritium	9/19/2001	ND	200	pCi/L	Primary
NEE10-TW	NE	1,000	Tritium	1/17/2002	ND	200	pCi/L	Primary

MDA = minimum detectable activity

TFWT = tissue free-water tritium

OBT = organically bound tritium

TW = transpired water

ND = not detected